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Dr. Hoy gave the section the benefit of his experience in copper implements. On this subject there is no doubt that he is right. On the second paper the author has bestowed a great deal of labor, whether he is right or not.

Mr. Rust has lived many years among the Indians, and was able to explain some things by his experiences. The implements exhibited were very similar to those from Honduras figured in "Flint Chips."

Mr. Hingston is a surgeon of Montreal, and has been a keen observer of fecundity, longevity and vitality among Canadians, mixed up of English, Scotch, Irish and French, with a considerable sprinkling of Indians, but no German or other Europeans than those above mentioned.

Dr. DeHass, in his papers, gave the benefit of his own personal experience in exploration, and in one of them brought together all the various instances in which the antiquity of man has been alleged on our continent. We have seen these stories frequently before in different places, but Dr. DeHass has certainly done a great service in making them stand up in a line together.

The next meeting will be in Minneapolis, where more strenuous efforts must be put forth to make our section the best of all.

GEOLOGY AND PALÆONTOLOGY.

THEORIES OF THE ORIGIN OF THE LOESS.—Baron Richthofen (Geol. Mag. July, 1882) writes upon the origin of the Loess, in answer to H. H. Howorth. He states that, petrographically, stratigraphically and zoologically the Loess differs from all other formations; that in its nearly perfect homogeneousness it contrasts strongly with sedimentary strata deposited in shallow water; that between ridges of considerable height it fills up the hollows, presenting a concave surface; that its composition is everywhere hydrated silicate of lime, with some quartz and mica; that there is no stratification; that the tubes, incrusted by carbonate of lime, may be seen taken up by rootlets where vegetation occurs; that the shells are almost all land shells; that the mammalian remains are those of animals living on the steppes; and that whenever the Loess fills a basin between two hills, the slopes are covered by angular fragments of the adjoining rock. Water action will not explain these facts. Wind action will. Repeated depositions and repeated growths of grass explain the capillary structure. Dust storms in the present age deposit a measurable thickness of yellow dust wherever there is vegetation, and in districts where grass is the chief growth, successive deposits may reach hundreds and thousands of feet.

The steppe basins of Mongolia have a structure similar to that of the Loess, and all that is needed to give those basins the characteristic Loess scenery is water and an outward drainage.

Baron Richthofen's paper is followed by a continuation of Mr.

Howorth's, giving the evidence of the valley terraces in favor of a great post-glacial flood; and in the succeeding number Mr. Howorth publishes a rejoinder to Baron Richthofen. He urges that he, as well as Baron Richthofen, believes in the original sub-aerial nature of the deposits, as proved by the animal and vegetable remains, but that what is called the Loess is this old land surface redistributed by the catastrophe which closed the Mammoth period and formed the gap between Palæolithic and Neolithic man. He denies that the genera and most of the species of mammals found in the Loess are such as now abound in steppes, for the mammoth and the rhinoceros, the characteristic quadrupeds, are forest animals; and he asserts that the probabilities are that the lime-lined capillary tubes, which do not occur at a greater depth than 45 feet, were formed by the percolation of water. Wind-driven deposits would be sorted, the heavier dropped first, whereas heavy grains occur throughout the Loess, mixed with the lighter. Baron Richthofen asserts that the Loess-covered portions of Europe must have had a steppe climate long enough for the deposit to be formed, but if so, how could the Helices and other damp-loving molluscs exist? Whence did the dust come to form this vast deposit? Wind blowing over grass raises no dust. As, according to Baron Richthofen the steppes of Mongolia are really Loess, and as the Loess is known to exist in Russia, where can we possibly look for a dry area large enough to supply this dust?

Mr. S. V. Wood contributes an additional theory to this much vexed question. In arctic climates where the soil is not covered by ice, the surface would annually thaw and be converted into mud by the melted snow. On all inclined surfaces it would slide downward from the frozen soil below, and thus leave a fresh surface exposed to the same agencies. Repeated depositions of this mud would fill the valley, and constitute the Loess.

THE RECENT DISCOVERIES OF FOSSIL FOOTPRINTS IN CARSON, NEVADA.—Monday evening, Aug. 28th, the California Acad. of Scien. held a special meeting, with Vice-President Justin P. Moore in the chair, to hear a carefully prepared paper on the "Carson Footprints," read by Joseph Le Conte, M.D., L.L.D., Professor in the Universityof California. He began by explaining that his attention was first attracted to the Carson prison stone quarry in 1868, when he received from it the tooth of a species of the horse. On June 20th, 1882, he first reached the quarry and saw the footprints now uncovered, and found there the Committee of the Academy diligently at work, with whom he, as only a member, desired most heartily to coöperate. He then described the locality as a remnant of a sandstone elevation, which had been cut into by erosion. An opening about 100 yards square had been quarried into the ledge, which is surrounded on three sides by vertical cliffs from 10 to 32 feet high, on the floor of which the nearly level strata appear well exposed. The strata consist of heavy bedded, grayish and creamy sandstone, separated by thin layers of shale. The sandstones in many places, especially in the eastern cliff, are strongly affected with cross laminations, indicating deposit by rapid shifting, overloaded currents—in other words, river flood deposits. We have, therefore, the mouth of an ancient stream. There appear to have been two shale floors about two feet apart, on which layer tracks are found. The whole area uncovered is literally strewn with these tracks. Parts of the area cleared have been trampled over by men and horses for eight or ten years, without attracting scientific attention. Their importance was first recognized by the intelligent Warden, Major Garrard, and their hardness has been the means of preserving them. Besides the tracks, a considerable number of fossils have been found which may assist in determining their age. Among these are fragments of tusks and molars of an elephant, and molars and fragments of jaws containing molar teeth of two species of horse. These were but imperfectly petrified. Two species of fresh-water shells have been found, an Anodonta and Sphærium, also one Gastropod, Physa. Vegetable remains are also abundant, occuring mostly as matted masses of silicified herbaceous plants. The age of the strata seems difficult to determine, but judging from the mammalian remains alone, there can be no doubt that the deposit is either Quaternary or the Upper Pliocene.[1] The molars discovered at Carson, above the tracks, indicate the *Elephas primigenius* rather than the *americanus*. The teeth of the horse indicate the *Equus major*, which although similar to modern horses, was somewhat larger. The lithification of the strata and fossilization of plants and organic remains, and the slight tilting of the strata, may be adduced as evidence of an earlier age than the Quaternary. The strata somewhat resemble a lake terrace deposit. Although Miocene lake deposits are here not far off, Professor Le Conte thought the presence of horse and elephant a bar to that age. The ancient Pliocene lake was the most extensive, covering the whole basin region from the Sierra Nevada to the Wahsatch. Its extensive deposits have been largely covered up by the later deposits of the two great Quaternary lakes in the same region. Carson plains was about 240 feet above the level of these latter lakes; hence, a smaller and very shallow contemporaneous lake must have existed at a higher level, probably emptying into the greater lake.

The tracks supposed to be human naturally excite the greatest interest, being several hundred in number. No one who studies them can fail to observe their remarkable general resemblance to human tracks, both in their form and in the apparent singleness of each impression. Their size calls for explanation; although well defined as rights and lefts, their straddle is unusually wide. He thought they might have been made by a human foot enclosed in a rawhide sandal much larger externally than the foot. This would at first make a flat track until soaked through, after which it would leave a round impression, but no toe marks. If not by man the tracks could only be made by some clumsy plantigrade quadruped like a bear or a gigantic ground sloth, Mylodon, such as lived in the Quaternary. Professor Le Conte desired to hold his final scientifically expressed opinion in reserve, awaiting further testimony. The interest among scientific men is intense on any subject calculated to show evidence of the antiquity of man, especially in Pliocene or Miocene ages.

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[1] The age was indicated as Pliocene from specimens sent one of the Editors, in the NATURALIST, March, 1882, p. 195.

ORIGIN AND MODE OF FORMATION OF SALINE MINERAL WATERS.—M. Dreulefait, in a lecture upon this subject recently delivered before the French Scientific Association, took occasion to discredit the usual theories which attribute the formation of the beds of the gypsum, rock-salt, etc., that mineralize such waters, to the action of sulphuric acid from the depths of the globe, or to any other *internal* agency, and to attribute their origin entirely to causes acting *exteriorly* to the primitive crust of the earth.

The rocks forming the first solid envelope must have solidified at a temperature of 2000° to 2500° C., at which chlorine, sulphur and their combinations must have existed completely disassociated in the atmosphere. Chloride of sodium would form at a comparatively high temperature because it can support such a temperature without disassociation of its elements, but chloride of magnesia could not, since it decomposes at 100 C. in the presence of water, have been formed until the temperature of the earth was about 100 C., and the greater part of the water was already condensed.

Here, then, is the source of the salts found in the earth's crust, in the sea, and in mineral waters. The water, condensed by the lowered temperature, dissolved the soluble salts already deposited, as well as those continuously produced by the action of the acids within it. These salts were principally sulphides and chlorides produced by the union of sulphur and chlorine with the metals sodium, lithium, potassium, calcium, and magnesium already deposited in the more ancient crust of the earth.

Thus the masses of chloric and sulphuric salts which exist in the sedimentary beds of the globe have been formed by the spontaneous evaporation of isolated portions of the ocean.

This can be verified by the facts which occur in the evaporation of sea-water for the production of salt. The substances precipitated, in the order of their occurence, are :

1. A feeble deposit of carbonate of lime with traces of strontian, and of sesquioxyde of iron mixed with a little manganese.

2. Gypsum. This deposit does not occur until the water has by evaporation diminished to one-fifth of its original volume.

3. Common Salt. The deposit of gypsum ceases when .88 of the original volume of water has evaporated, and that of salt commences when only one-tenth of the volume remains, and continues till that quantity has been reduced one-half.

4. Sulphate of magnesia. A still further evaporation causes the deposition of this salt, mingled however, with chloride of sodium. When the only three parts out of a hundred remain, the quantities of sulphate of magnesia and common salt are equal.

5. Carnallibe, or double chloride of potassium and magnesium. This is deposited when the water has been reduced to a little less than one-fiftieth of its original volume.

Spontaneous evaporation goes no further; a bitter mother liquor is left that never dries at the ordinary temperature of the hottest regions of the globe. This liquor contains much chloride of magnesium.

Taking these facts in their order, and applying them to the saline beds found in different parts of the earth, it is evident that the substances last deposited must be rarest, since at each stage the evaporation is more advanced, and the chances favorable to further deposition diminished. This is borne out by the facts, since gypsum is most common, chloride of sodium next. We may also predicate that if one of the substances last deposited in artificial evaporation be found in the crust of the earth, beds of all those substances which are previously deposited will be found around it. This is always the case, gypsum occurs without common salt, but never common salt without gypsum. At Strassfurth, Prussia, all these substances occur, with, in addition, boracic acid combined with magnesia. Chemists have been of opinion that since "borate of magnesia is almost insoluble in water, it ought to have been deposited in the inferior beds," and have appealed to volcanic agency to explain its occurrence. Analysis, however, shows that boracic acid exists in the mother liquor left after evaporation, and in such quantity that spectral analysis, or the flame of hydrogen, reveals its presence in a single drop.

Thus boracic acid, occurring abundantly in the midst of the deliquescent salts of the mother liquor, ceased to be a rare substance, and may be expected to be found where deposits of gypsum and salt occur, and there only. M. Dreulefait goes on to state that he has proved his deductions by observations carried on throughout a considerable portion of Southern Europe and Northern Africa, and has come to the conclusion that the presence or absence of volcanic agencies makes no difference to the quantity of boracic acid found in saliferous districts. The salt springs of the non-volcanic parts of the south of France, Switzerland, and Germany are as rich in boracic acid as those of the ophitic districts of Engadine or the Pyrenees.

The lecturer then treated of the salt pools formed in the delta of the Rhone, and showed how they are repeating the action by which the older beds of gypsum and salt were formed. The Karabogaz or Black Gulf on the east of the Caspian sea has already deposited the remains of all its forms of life, and is nearly ready to deposit gypsum. A narrow channel communicates with the Caspian, through which it can be calculated that 350,000 tons of solid matter pass in twenty-four hours, ever to remain in the gulf, since the channel is too shallow to admit of any counter-current. Complete separation, which must ultimately be caused by the proved lowering of the level of the Caspian itself, will in time cause the Karabogaz to become concentrated sufficiently to deposit its chloride of sodium.

The water of the dead sea is a mother liquor, from which the saline masses found around it have been derived. M. Lorbet, in his explorations of Palestine, discovered, especially around Lake Tiberias, now 212 metres below the Mediterranean, a plateau covered with rolled pebbles exactly at the level of that sea, and indicating that at a former epoch Lake Tiberias, the Jordan valley, and the still lower Dead sea, with the regions around them, formed a gulf like that of Karabogaz or like the pools of the estuary of the Rhone.

THE SO-CALLED LEADVILLE PORPHYRY.— Professor Alexis Julien read a paper at the Montreal meeting of the American Association, on this subject, in which he described the result of his examination of the rock in question, in thin sections under the microscope. He finds that it is not an eruptive rock, but is sedimentary. Its material consists of the debris of the erosion of plutonic rocks, redeposited in the Silurian ocean. He concludes that the rock is not a porphyry but must be called a felsite tufa. The importance of this conclusion in estimating the form of any metallic ores contained in this deposit, is obvious, and will be invaluable to mining experts.

PERMIAN VERTEBRATA.—Professor Cope read a paper before the American Philosophical Society in which he described the pelvic arch of the *Diadectidæ*, and the following new species from the Texas Permian: Pelycosauria, *Edaphosaurus* (g. n.) *pogonias*, which is allied to *Pantylus*, and proves that that genus must be placed in the Theromorphous order. *Ectocynodon aguti*. Microsauria, *Diplocaulus magnicornis*, a remarkable species with a large flat horn on each side of the cranium. Rachitomi, *Acheloma* (gen. allied to Eryops) *cumminsi*, and *Anisodexis* (g. n. allied to *Leptophractus*) *imbricarius*.

GEOLOGICAL NEWS.—In the *American Journal of Science*, S. H. Scudder shows that Palæocampa, from the carboniferous strata of Illinois, is a myriapod of a new and strange type. Palæocampa has ten equal body segments, each with a pair of stout, blunt legs, and four stiff-spreading bunches of spines of complex structure.

The Archipolypoda of the Mazon creek nodules have stout forked spines and two pairs of legs to each segment. Palæocampa may therefore be considered as a precursor of the Chilopoda, just as the Archipolypoda are the precursors of the Diplopoda, and the discovery of these types prove that at this early period the divergencies of structure among myriapods were as great as they are to-day.——In the same journal Messrs. McGee and Call write upon the Loess of Des Moines, Iowa, giving faunal tables of the fossils, which have a less aquatic facies than the modern mollusca of the same district.——Messrs. Scott and Osborn describe *Orthocynodon*, an ancestor of the Rhinoceros, from the Bridger Beds of Wyoming. It is the oldest known representative of the line, and differs from Amynodon in the erect lower canines, similarity of premolars and molars and other particulars. He has little of the rhinocerotic character in the skull, but the possession of canines and loss of the median incisors point it out as related to Amynodon.

MINERALOGY.[1]

THE ACTION OF HEAT UPON CRYSTALS OF BORACITE.—Mallard contributes to the Mineralogical Society of France an interesting paper upon the change which heat produces in the optical properties of boracite. The leading mineralogists of Germany—Klein, Zirkel, Groth, etc., hold that such changes are due simply to unequal internal tension, such as may be produced in glass. That the biaxial character caused by heat is an essential and characteristic character of boracite, due to the twinning of twelve rhombic crystals around a point, is again strongly urged by Mallard in the present paper. He supposes each individual of the *pseudo-symmetrical* crystal to be a pyramid whose base forms a face of the external dodecahedron, and whose summit is at the center of the crystal. By cutting sections in various directions through the crystal, and examining them optically both before and after heating, he shows that there are persistent optical properties which cannot be explained by irregular tension. He concludes that by the action of an intense and prolonged heat, a series of very thin plates are formed, alternately twinned with each other according to a definite crystallographic law. He shows that analogous phenomena may be produced by the action of heat upon sulphate of potash, and that such invariable phenomena could not be produced by tension or pressure in a colloid substance.

PREHNITE.—This zeolite, so frequent in rocks of igneous origin, and recently found to so frequently exhibit curious optical properties, has been carefully described by Professor B. K. Emerson in its associations and alterations in the Deerfield Dike of Connecticut. Prehnite is regarded as the oldest mineral in the veins in which it appears. Frequently the motion of the rock walls produces slickensides upon the prehnite, and sometimes

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[1] Edited by Professor H. CARVILL LEWIS, Academy of Natural Sciences, Philadelphia, to whom communications, papers for review, etc., should be sent.